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THE NEARCTIC SPECIES OF TRIGONALID WASPS

By Henry Townes [1]

The Trigonalidae is a small family of Hymenoptera, of which only four species belonging to four genera are known in the Nearctic Region. All of them are parasites, usually secondary parasites, and their hosts include Vespidae, Pergidae, and dipterous and hymenopterous parasites of caterpillars.

Adult trigonalids look somewhat like medium-sized sawflies or wasps. The relationships of the family appear to be with the Aculeata and it fits best in the Chrysidoidea (including the Bethyloidea), but it is aberrant wherever placed and the natural relationships of the families of Apocrita will have to receive a general study before the proper position of this family can be stated with confidence. Characters by which trigonalids may be distinguished from other families of Apocrita are: Flagellum with 14 to more than 20 segments; costal cell of forewing present; hindwing with distinct venation and two closed cells; anal lobe represented by a small vestige; and legs usually with two but sometimes with one trochanter each. Figure 1,*a* illustrates a typical member of the family.

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Trigonalids have a peculiar life history which has been reviewed for several species by Clausen (Entomophagous insects, pp. 56–61, 1940). Their minute and very numerous eggs are laid at random on foliage and subsequently eaten by caterpillars or sawfly larvae. In the case of the species which are secondary parasites of caterpillars, the eggs hatch in the gut of the caterpillar and the trigonalid larva enters the body of the caterpillar to attack an ichneumonid, larvaevorid, or other parasitic larva. Those species parasitizing social Vespidae presumably find their host when caterpillar prey containing trigonalid larvae are brought to the nest as food for the young. Individuals of the various species tend to vary considerably in size, an indication that they have a wide range of hosts. The species *Lycogaster pullata* has been reared as a parasite both of *Enicospilus americanus* (Ichneumonidae) and of *Rygchium rugosum* (Vespidae), indicating an exceptionally versatile host adaptability.

Most of the specimens studied are in the U. S. National Museum (USNM). The locations of specimens in other institutional collections are indicated (in parentheses) by the name of the city in which they are stored.

Key to the Nearctic genera of Trigonalidae

1. Postscutellum roughly pyramidal, the apex bifid; legs of female each with a single trochanter . . . . . **4. Bareogonalos**
   Postscutellum not pyramidal, of normal shape, not elevated; legs of female each with two trochanters 2
2. Propodeal foramen bounded dorsally by a carina or ridge that is evenly curved; second tergite not punctate; second sternite of female without a tooth. **1. Orthogonalys**
   Propodeal foramen bounded dorsally by a carina or ridge that is sharply angled medially; second tergite punctate; second sternite of female with a strong median apical tooth 3
3. Antenna slender, the median segments about 2.0 as long as wide; male antenna with tyloids; occipital carina not joining the hypostomal carina, reaching the mandible; third sternite of male simple . . . . . **2. Poecilogonalos**
   Antenna thick, the median segments about 1.6 as wide as long; male antenna without tyloids; occipital carina joining the hypostomal carina; third sternite of male with a strong transverse groove . . . . . **3. Lycogaster**

Genus *Orthogonalys* Schulz

Orthogonalys Schulz, Hymenopteren-Studien . . . p. 76, 1905. Type: *Orthogonalys bolivana* Schulz. Monobasic.

Orthogonalos Schulz, *in* Wytsman, Genera insectorum, fasc. 61, p. 8, 1907. Emendation.

Tapinogonalos Schulz, *in* Wytsman, Genera insectorum, fasc. 61, p. 14, 1907. Type: *Trygonalys pulchellus* Cresson. Designated by Viereck, 1914.

Noteworthy generic characters in addition to those in the key are: Flagellum long and slender, in the male without tyloids; abdomen smooth, impunctate; apical margin of second to fifth tergites often

with a broad weak median notch; frons only weakly elevated next to the upper inner margin of the antennal foramen.

There is a single Nearctic species, which is moderately common in the Eastern States.

***Orthogonalys pulchella* (Cresson)**

Trigonalys pulchellus Cresson, Proc. Ent. Soc. Philadelphia, vol. 6, p. 351, 1867. Type: Male, West Virginia (lost).

Tapinogonalos pulchella Schulz, *in* Wytsman, Genera insectorum, fasc. 61, pl. 2, figs. 56–58 (colored), 1907.

Male: Forewing about 8 mm. long. Colored with black, pale yellow, and fulvous, to mimic the *Taxonus pallidicornis—Cratichneumon signatipes* type of coloration. Head and mouthparts yellow, the occiput, vertex, and median part of frons black; vertex with a pair of yellow spots behind the ocelli; antenna black, its scape yellowish beneath and brownish above, its flagellum with a broad whitish postmedian band; thorax blackish above with conspicuous yellow markings, yellowish laterally with black bands along the sutures separating off the yellow areas, mostly yellowish below, the mesosternum mostly fulvous; wings hyaline; legs fulvous, the trochanters and much of the coxae pale yellow; abdomen fulvous with a pair of fuscous areas basally on the second tergite and often similar areas or transverse subbasal fuscous bands on several of the following tergites.

Female: Forewing about 8.5 mm. long. Colored like the male but with the yellow markings tending to be paler, almost white, the fuscous markings on the abdomen tending to be more as crossbands, and each of abdominal tergites 1 to 5 usually with a lateral white blotch.

Specimens: 27 ♂♂, 39 ♀♀ from: District of Columbia; New Jersey (Moorestown); Maine (Paris); Maryland (Bowie, Cabin John, Glen Echo, Lock Raven, Takoma Park, and Plummers Island); Massachusetts (Chester); New York (Farmingdale, Ithaca, Ludlowville, Niagara Falls, and Taughannock); Pennsylvania (Enola and Highspire); Rhode Island (Westerly); and Virginia (Alexandria, Dead Run, Falls Church, Great Falls, and Rosslyn).

Males occur mostly in June and early July, their earliest and latest dates of capture being May 25 at Plummers Island, Md., and July 21 at Ithaca, N. Y. Females occur mostly from mid-June to mid-August. Their extreme dates are June 7 at Plummers Island, Md., and Aug. 23 at Niagara Falls, N. Y. This seasonal distribution indicates a single generation per year. There is a rearing record by Bischoff (Berliner Ent. Zeitschr., vol. 54, p. 76, 1909) from *Zenillia lobeliae* (Larvaevoridae), which was parasitic on *Acronicta lobeliae* (Noctuidae).

Females have been seen ovipositing on several occasions. Notes made on June 20, 1942, at Takoma Park, Md., are as follows: Two females were seen ovipositing in midafternoon. They were in rank undergrowth of damp woods, about 40 cm. above the ground. They ran over the leaves in the manner of a *Macrophya*, about every four seconds going quickly to the edge of a leaf and curling the abdomen over the edge to oviposit on the undersurface near the edge. This oviposition movement was very quick, being completed within a second. The eggs were distributed at random, one or more to a leaf. One female was ovipositing on *Viburnum acerifolium* and the other on a composite similar to *Sericocarpus*. On June 21 a third female was caught and confined in a jar with fresh leaves of *Liquidambar*. On June 23 it was dead. Examination of the leaves showed 8 to 10 extremely minute, elongate-oval eggs, presumably laid by this female, loosely attached to the leaves about 2 mm. from the edges.

REMARKS: This is a species of the Transitional Zone of the Eastern States. Adults are moderately common from early summer to midsummer in damp rich woodlands, where they occur on the foliage at about the 35-centimeter level. They crawl over the foliage or take short flights. In size, coloration, and movements they mimic several of the species of sawflies and ichneumonids that are common in the same habitat.

Genus *Lycogaster* Shuckard

Lycogaster Shuckard, The Entomologist, vol. 1, p. 123, 1841. Type: *Lycogaster pullata* Shuckard. Monobasic.

There is a single Nearctic species, which is divisible into two subspecies.

Lycogaster pullata Shuckard

Forewing of male about 6 mm. long, of female about 9 mm. long.

This species is transcontinental in the Transition Zone. Fragmentary evidence indicates that it occurs in more open and dry habitats than the other Nearctic trigonalids. It is represented by an eastern and a western subspecies, as indicated below.

Key to the subspecies of Lycogaster pullata

1. Tibiae black, the middle tibia white basally and the front and hind tibiae white basally and externally; abdomen black, often with some white marks; range: Atlantic Coast west to 100th meridian.
(a) pullata pullata Shuckard

Tibiae pale yellow, the hind tibia often infuscate apically on the posterior side; abdomen black with broad pale yellow bands; range: Nevada, Colorado, North Dakota, and New Mexico . . . **(b) pullata nevadensis** (Cresson)

(a) *Lycogaster pullata pullata* Shuckard

Lycogaster pullatus Shuckard, The Entomologist, vol. 1, p. 124, 1841. Type: Female, North Carolina (destroyed).

Lycogaster pullatus var. *hollensis* Melander and Brues, 1902. Biol. Bull., vol. 3, p. 36, 1902. Types: Male and female, Woods Hole, Mass. (location unknown).

Lycogaster pullata Bischoff, Berliner Ent. Zeitschr., vol. 54, pp. 76–77, 1909. Biology.

Lycogaster pullata Schulz, Zool. Ann., Wurzburg, vol. 4, pp. 7–8, 1911. Biology.

Lycogaster pullata Cooper, Proc. Ent. Soc. Washington, vol. 56, pp. 280–288, 1954. Biology.

Male: Black. Bases of tibiae, anteroexternal face of front tibia and usually also of hind tibia, most of basitarsi except apices, hind corner of pronotum, and usually lateroapical blotch on some or all of tergites 2 to 5 white; tegula brown; wings hyaline, their apical 0.4 faintly infuscate.

Female: Colored like the male except that the white markings average a little more extensive. The specimen from Bottineau, N. Dak., noted below, has coloration intermediate to the subspecies *nevadensis*.

Specimens: 5 ♂♂, 20 ♀♀ from: District of Columbia; Maryland (Glen Echo); Massachusetts; Michigan (Midland County, Missaukee County, and Roscommon County); New York (Ithaca); North Carolina (valley of the Black Mountains); North Dakota (Bottineau); Rhode Island (Westerly); Vermont (Fairlee); and Virginia (Falls Church, Glencarlyn, and Upton).

Dates of collection fall in June and July except for two collections in May and one in August (May 9 at Glencarlyn, Va.; May 19 in the District of Columbia; and August 25 at Bottineau, N. Dak.).

One specimen bears the note that it was collected on *Solidago* and another on *Ceanothus*. A male specimen in the U. S. National Museum that was taken from a cocoon of *Telea polyphemus* in June 1944 by C. Brooke Worth has some manuscript notes associated with it which are of unusual interest. Mr. Worth states that the cocoon was collected at Washington, D. C., during the winter of 1944. Since it had not hatched and was very light, the cocoon was opened June 13, 1944. The trigonalid was within the *polyphemus* cocoon, which also contained a perforated parasite cocoon, presumably that of *Enicospilus americanus* (Ichneumonidae). The ichneumonid cocoon contained some liquid and semiliquid material among which could be identified the apparent remains of an ichneumonid larva and its meconium. The trigonalid was between the walls of the moth cocoon and the ichneumonid cocoon, alive and active. Schulz (1911) reports rearing this species from a cocoon of *Enicospilus americanus* within a cocoon of *Telea polyphemus*, a situation similar to that noted

by Mr. Worth. Also, Bischoff (1909) reports a rearing from *Enicospilus americanus* parasitizing *Telea polyphemus*. Cooper (1954) describes in detail a case of parasitism of *Rygchium rugosum* (Vespidae). J. C. Bridwell has informed me in conversation that he has seen the species ovipositing on oak sprouts in the vicinity of Washington, D. C.

(b) *Lycogaster pullata nevadensis* (Cresson), new status

Trigonalys nevadensis Cresson, Proc. Ent. Sec. Acad. Nat. Sci. Philadelphia, p. vii, *in* Trans. Amer. Ent. Soc., vol. 7, 1879. Male and female. Type: Female, Nevada (Philadelphia).

Lycogaster nevadensis Schulz, *in* Wytsman, Genera insectorum, fasc. 61, pl. 2, figs. 32–37 (colored), 1907.

MALE: Black. Hind corner of pronotum, much of tegula, a bilobed spot on scutellum, apices of femora, tibiae, broad apical margins of tergites 1 to 4, broad apical margin or lateroapical triangle on sternite 1, and lateroapical corners of sternites 2 to 4 pale yellow; tarsi pale yellow, brownish apically; wings yellowish hyaline, their apical 0.4 faintly brownish; hind tibia sometimes with a brown apical mark on the posterior side.

FEMALE: Colored like the male except that the yellow marks on the abdominal terga average a little broader, the hind tibia more frequently has the brown apical mark, and the lower front corner of the pronotum is narrowly marked with yellowish.

SPECIMENS: Male, bred from *Hyphantria cunea* (probably as a secondary parasite), Boulder, Colo., Sept. 29, 1937, R. B. Swain (USNM); 3 ♂♂, 6 ♀♀, bred from *Hyphantria cunea* (probably as a secondary parasite), Boulder, Colo., Oct. 17, 1937, R. B. Swain (USNM); ♀, Colorado, C. F. Baker collection (USNM); ♂, Jemez Springs at 6,400 ft., N. Mex., June 24, 1916, John Woodgate (Ithaca); ♀, Corvallis, Oreg., Apr. 28, 1941, H. A. Scullen (Corvallis); ♂, Martin, S. Dak., June 16, 1925, H. C. Severin (Cambridge).

Genus *Poecilogonalos* Schulz

Poecilogonalos Schulz, *in* Wytsman, Genera insectorum, fasc. 61, p. 9, 1907. Type: (*Trigonalys pulchella* Westwood) = *thwaitesii* Westwood. Monobasic.

This is a rather large and widely distributed genus, but with only a single representative in the United States.

Poecilogonalos costalis (Cresson)

FIGURE 1

Trigonalys (*Lycogaster*) *costalis* Cresson, Proc. Ent. Soc. Philadelphia, vol. 6, p. 352, 1867. Type: Male, Massachusetts (Philadelphia).

Trigonalys sulcatus Davis, 1898. Trans. Amer. Ent. Soc., vol. 24, p. 349, 1898. Type: Male, Angelsea, N. J. (Philadelphia).

MALE: Forewing about 7 mm. long. Black. Front orbit, part of hind orbit, clypeus except apical margin and usually a median area, a spot above antennal socket, front face of mandible, anterior part, upper edge, and hind corner of pronotum, a line inside of notaulus, a narrow line on mesoscutum next the forewing, a mark on upper part of mesopleurum, a pair of large spots on scutellum, most of postscutellum, a pair of spots on propodeum, a yellow apical band on second tergite, narrower apical bands on most of the other tergites, large lateral apical dashes on second sternite, usually similar but smaller marks on some of the other sternites, and most of legs yellow; coxae, except apically, blackish; femora behind and often above brown; hind tibia apically brownish; flagellum tinged with fulvous beneath; wings hyaline, the front wing brown anteriorly, darkest in the radial cell.

FEMALE: Forewing about 7.5 mm. long. Colored similar to the male but with the yellow marks a little more extensive. The apical tooth on the second sternite is deeply notched.

SPECIMENS: 22 ♂♂, 28 ♀♀ from Maryland (Cabin John, Plummers Island, and Takoma Park); Massachusetts (Falmouth); New York (Huntington, Ithaca, Taughanic, West Point, and Woodlands); North Carolina (Burnsville, Hamrick, Southern Pines, and valley of the Black Mountains); Ohio (Ross County and Scioto County); Pennsylvania (Castle Rock, Dauphin, Glenside, and Mount Holly Springs); South Carolina (Greenville); Virginia (Arlington, East Falls Church, Falls Church, Glencarlyn, Great Falls, Mount Vernon, Rosslyn, and Vienna); and West Virginia (Kanawha Station).

Collection dates are mostly from June 25 through August 4, with no apprent trend towards protandry. Dates outside of this range are: June 10 in Scioto County, Ohio; June 15 at Plummers Island, Md.; August 19 at Hamrick, N. C.; August 30 and September 6 at Falls Church, Va.; and October 31 at Southern Pines, N. C. One male and two females were reared from *Phosphila turbulenta* (Noctuidae), probably as a secondary parasite, at Falmouth, Mass., June 30, 1928, and July 11, 1928. One male was collected at honeydew on *Liriodendron*.

REMARKS: This species is seen in semishade of rich woods with abundant undergrowth, at the 20- to 40-centimeter level. In general appearance it resembles a robust sphecoid wasp but may be distinguished in life by its slender, fast vibrating antennae. The oviposition habits are generally similar to those described for *Orthogonalys pulchella*, but the females move more quickly and seem to scatter their eggs more widely. They take a little longer to place each egg and appear as if inserting them through the lower epidermis into the leaf tissue. In this action the heavy tooth on the apex of the second sternite appears to hold the upper edge of the leaf while the apex of

the abdomen curls under and implants the egg with pressure against the tooth on the upper side of the leaf. In general, the species is widely distributed in the Transition Zone of the Eastern States. It occurs mostly in midsummer, in partially sunlit openings of rich woods.

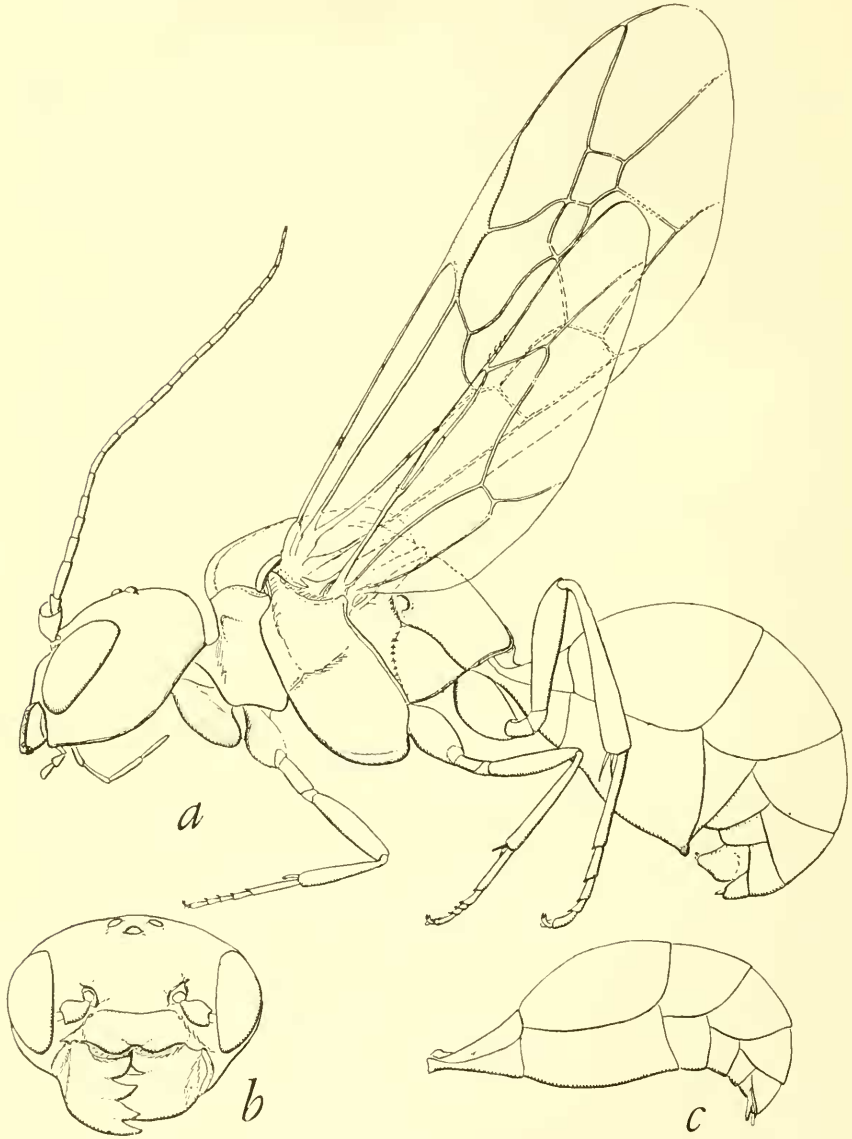

FIGURE 1.—*Poecilogonalos costalis: a*, female, side view; *b*, head, facing view; *c*, abdomen of male, side view.

Genus *Bareogonalos* Schulz

Bareogonalos Schulz, *In* Wytsman, Genera insectorum, fasc. 61, p. 18, 1907. Type: *Trigonalys canadensis* Harrington. Monobasic.

Nippogonalos Uchida, Ins. Mats., Sapporo, vol. 3, p. 79, 1929. Type: *Nippogonalos jezoensis* Uchida. Original designation.

This genus is easily distinguished by its pyramidal postscutellum, bifid apically, and the 1-segmented trochanters of the female. The members of the genus are larger and more robust than the average trigonalid. *Vespa* and *Vespula* have been recorded as hosts.

Through the generosity of Prof. T. Uchida I have been able to compare specimens of the Japanese species *B. jezoensis* with the American *B. canadensis*. They are rather closely related. The Japanese species has the scutellar elevation lower, thoracic sculpture a little coarser, and the coloration of the forewing different. In *jezoensis* the forewing is subhyaline with the apical 0.4 lightly infuscate; in *canadensis* the forewing is yellowish hyaline with the radial cell rather strongly infuscate and the apical margin faintly, broadly infuscate.

Bareogonalos canadensis (Harrington)

Trigonalys canadensis Harrington, Canadian Ent., vol. 28, p. 108, 1896. Female misdetermined as male. Type: Female, Victoria, B. C. (lost).

Trigonalys canadensis Taylor, Canadian Ent., vol. 30, pp. 14–15, 1898. Biology.

Trigonalys canadensis Harrington, Canadian Ent., vol. 30, pp. 14–15, 1898. Description of male.

Bareogonalos canadensis Schulz, *in* Wytsman, Genera insectorum, fasc. 61, pl. 3, figs. 82–90 (colored), 1907.

Male: Forewing about 8.5 mm. long. Black. Hind corner of pronotum, postscutellum, lateral spot on propodeum, small marks on coxae, trochanters, bases and apices of femora, tibiae, tarsi and lateral triangular spots on tergites 2–6 (diminishing in size posteriorly) yellow; apical part of hind tibia tinged with brown; wings subhyaline, the radial cell and adjacent areas somewhat infuscate.

Female: Forewing about 11.5 mm. long. Colored like the male but with the yellow marks more extensive, the marks on tergites 2–6 broadened and fused into conspicuous transverse yellow bands, sternites 1 and 2 with yellow marks, scutellum mostly yellow, mesoscutum anteriorly with a yellow spot just inside the notaulus, a yellow spot just forward and laterad of the scutellum and of the postscutellum, and a small yellow spot on the mesopleurum.

Specimens: ♂, ♀, British Columbia, October 21 and 25, 1897 (Townes); ♂, British Columbia Biological Station, Departure Bay, British Columbia, Oct. 24, 1908 (Ottawa). In addition to these

three. I have had the opportunity to study briefly a number of specimens at Ottawa. These showed considerable variation in the extent of the yellow markings.

Harrington's type was taken from the cell of a wasp (probably *Vespula*) and Taylor records collecting 23 ♂♂ and 4 ♀♀ near nests of *Vespula pensylvanica*.

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